(19) PATENT BUREAU OF JAPAN (JP)
(12) OFFICIAL GAZETTE FOR GRANTED PATENTS (A)
(11) Japanese Patent Application Publication Kokai: H01-309044
(43) Publication Date: December 13, 1989
Number of Claims: 10
Request for Examination: Requested (Total of 6 pages)

(51) Int. Cl.[4]	ID Code	Internal Class.
G 03 B 42/04		A-7447-2H

(54) Title of Invention: Cassette for storage-type fluorescent sheet
(21) Patent Application No.: Japanese Patent Application S63-140196
(22) Application Date: June 7, 1988

(72) Inventors: KUBOTA HIDEO
FUJI PHOTO FILM CO., LTD., 798 Miyadai, Kaisei-cho, Ashigaraue-gun, Kanagawa-ken

(71) Applicant: FUJI PHOTO FILM CO., LTD.
210 Nakanuma, Minamiashigara-shi, Kanagawa-ken

(74) Agent: Patent attorney Takashi Yanagida, and one other person

---

Detailed Description

1. Title of the Invention:

Cassette for storage-type fluorescent sheet

2. Patent Claims:

A cassette for storage-type fluorescent sheet, characterized by the fact that it contains a removable storage-type fluorescent sheet, that when it is subjected to imaging signal-containing irradiation the above imaging signal is cumulatively recorded on the storage-type fluorescent sheet contained in the cassette, that the cassette for the storage-type fluorescent sheet is equipped with a signal generating device generating a detection signal upon detection of the above irradiation, and a time-displaying device displaying the time on the surface of the above cassette, and that, for the above time-displaying device, the display on the time-displaying device is stopped upon input of the above

detection signal with the stopping time continuously displayed on the surface of the above cassette.

3. Detailed Description of the Invention

(Field in the Industry)

The present invention is related to a cassette for storage-type fluorescent sheet, which contains a removable storage-type fluorescent sheet. In particular, it is related to a cassette for storage-type fluorescent sheet, which has the function of automatic display of photographing time.

(Prior Art)

It is well-known that when a fluorescent material is subject to irradiation (X-ray, α-ray, β-ray, γ-ray, ultraviolet ray, electron beam, etc.), a portion of the energy of the radiation is accumulated in the fluorescent material, and that when this fluorescent material is excited with visible light, etc., the accumulated energy results in light emission from the fluorescent material. A fluorescent material with such a property is called storage-type fluorescent material.

The inventors have previously proposed a radiation imaging information recording and regenerating system (Japanese Patent Application Publication No. S55-12429; ibid S56-11395). In that system, utilizing such a storage-type fluorescent material, radiation imaging information of an object, such as a human body, is temporarily recorded on a storage-type fluorescent sheet, and then the storage-type fluorescent sheet is scanned with an exciting light such as laser light for light emission. The emitted light is photoelectrically read to obtain an imaging signal. Based on this imaging signal, the radiation imaging information of the object is reproduced on a recording material such as photosensitive material or a display apparatus such as a CRT as a visible image.

This method, compared with the traditional irradiation photography system using silver salt photography, has a practical advantage in that it can record images over a very wide range of irradiation exposures. Thus, with a storage-type fluorescent material, it is recognized that in relation to the magnitude of the irradiation exposure light, the magnitude of the light emitted by excitation of the storage-type fluorescence is proportional over a very large range. Accordingly, even with large changes of the magnitude of the radiation exposure light under various photographic conditions, by

reading the magnitude of the light emitted from the storage-type fluorescent sheet by a photoelectric means, with the read-out gain set as an appropriate value, followed by conversion into an electronic signal, and then by using the electronic signal to output a visible image on a recording material, such as photographic photosensitive material or a display apparatus such as CRT, an irradiation image can be obtained which is not influenced by changes of magnitude of the irradiating exposure light.

With this system, the irradiation image signal recorded on the storage-type fluorescent sheet is converted into an electronic signal, and then, after appropriate signal treatment, the electronic signal is used to output a visible image on a recording material, such as photographic photosensitive material or a display apparatus, such as a CRT. Thus, an irradiation image of excellent suitability for reading and observation (suitable for diagnosis) can be obtained. This effect is highly significant.

In the above system, at the above storage-type fluorescent sheet after recording of an image signal (photography) within the photographing device, the signal is transferred to the reading device for reading of the photographic signal. The storage-type fluorescent sheet, in many cases, is contained in a cassette in a removable format. When photography is performed within the above photographing device, after the photography, the storage-type fluorescent sheet in the cassette is contained in the above reading device. When the cassette containing the photographed storage-type fluorescent sheet is placed in the reading device, at the reading device, the storage-type fluorescent sheet is removed from the cassette and transferred to a reading zone where the above reading is performed to read the image signal.

The image signal read as described above, is reproduced as a visible image in a reproduction device such as CRT or scanning recording device. On the reproduced image, sometimes there is a need for displaying photographing time along with the image signal. Thus, for example, for patients (people tested) with dramatic changes of their physical condition, photography may be performed several times a day. In such a case, to perform appropriate diagnosis it is necessary to display the photographing time on each reproduced image. Traditionally, before the above photography, the photographing time is input into an ID card, etc. along with patient name and sex and photographing site with an ID inputting means at the time of registration of the storage-type fluorescent sheet. The entered information is transferred to the reproducing device at the time of image

signal reproduction. Finally, it is added to the image signal, thereby being displayed on the reproduced image.

(Problems to be Solved by the Invention)

However, by the above method, the registration time of storage-type fluorescent sheet is the photographing time. If, for any reason, there is a time lag from registration to photography, the information becomes incorrect. Moreover, photographing time has to be entered manually, which is labor-intensive and inconvenient.

The present invention has been achieved considering the above problems. The objective is to provide a cassette for storage-type fluorescent sheet, with which the correct photographing time can be reproduced on the reproduced image by automatically displaying the photographing time without having to enter the photographing time at the registration of storage-type fluorescent sheet before photography.

(Means of Solving the Problems)

The cassette for storage-type fluorescent sheet of the present invention is characterized by the fact that it has a signal-generating device generating a detection signal from detection of irradiation with a radiation and a time-displaying device displaying the time on the surface of the cassette, that for the time-displaying device, the display on the time-displaying device is stopped upon entering the above detection signal into the time-displaying device, and that the stopping time, that is, the time of irradiation of a radiation, is thus displayed continuously on the surface of the cassette.

Moreover, the detection of irradiation with radiation can be direct detection of the radiation itself, or, as described below, indirect detection of irradiation with a radiation by detection of light emitted from the storage-type fluorescent sheet upon irradiation with the radiation. The above time-displaying device can display time on the surface of the cassette in any specific format, which can be detected by a detecting means. In addition to displaying the time by numbers and positions of hands as with a normal clock, the display also can be by changes of numbers on a display bar with time, or changes of color concentration on a displaying region.

(Function)

Using the cassette of the present invention, at the time of photography, the operation of the above time-displaying device is stopped, with the photographing time

displayed automatically on the surface of the cassette. When the cassette is placed in a reading device, the display on the surface of the cassette by time-displaying device is detected by a simple detecting means such as a miniature photoelectric reading means (e. g. CCD, etc.) or position sensor. The detection signal is transferred to the reproducing device, to reproduce the image signal as well as the photographing time as a visible image. Accordingly, manual operation for reproducing the photographing time is not needed, and the reproduced time is correct with little error.

(Practical Examples)

In the following, practical examples of the present invention are described with reference to figures.

Figure 1 shows an oblique view of the cassette for storage-type fluorescent sheet of a practical example of the present invention.

This cassette 2 allows for transmission of the irradiating radiation, but blocks light passage. It is composed of the cassette 2A containing the storage-type fluorescent sheet and a lid part 2B which is provided on the cassette 2A and can be opened and closed. On the surface of the above lid part 2B, the display part 12A of a time displaying means described below is provided. Before photography, the normal time is displayed, for example, on a liquid crystal 13, so that it is visible externally. Of course, the time displayed on the display part 12A changes at all time.

When photography is performed on the storage-type fluorescent sheet loaded within, the cassette 2 is placed in photography room, as shown in Figure 2, so that it is between the source of a radiation such as X-ray and a person being examined 3 with the side opposite to the lid part 2B facing the person. When this situation is set up, the source of radiation is initiated. The irradiation image after transmission through the person being examined 3 is projected on the storage-type fluorescent sheet 1, thereby the irradiation image signal of the person being examined 3 is accumulated and recorded on sheet 1. On the other hand, within the above lid part 2B, a signal generating means 10 that detects the radiation photographically and generates a detection signal S_1, the time displaying means 12 having the displaying part 12A described above, and a driving means 11 driving the time displaying means 12, consisting of a battery 11A and an amplifier 11B, are provided. The time displaying means 12 is driven by the above

driving means 11. Before photography, it displays the time. When photography is performed as above, automatically, the photographing time is displayed continuously.

The above signal generating means 11 [Error in Japanese text, should be 10. – Translator] is composed of a light emitting means 10A, comprising a fluorescent material that emits light upon irradiation of a radiation 4, and a photosensor 10B that detects the light emitted from the light emitting means 10A. The above light emitting means 10A emits light at the time when irradiated with radiation during photography. The detection signal S_1 is produced by photosensor 10B that has detected the light. The detection signal S_1 is transferred to the above driving means 11. The driving means 11 stops the display of the time displaying means 12 when the detection signal S_1 is entered . The stop time, that is, the photographing time, is displayed continuously on the above display part 12A. Accordingly, after photography, if the cassette containing the storage-type fluorescent sheet 1 is looked at on the outside, the photographing time is visible in a format of "oo hour oo minute". Moreover, the storage-type fluorescent sheet 1 emits light all over it upon irradiation with a radiation (the so-called instantly emitted light). The above signal detecting means 10 can also detect the instantly emitted light and then produce the detection signal. In this case, a storage-type fluorescent layer normally formed only on the face of the side of irradiation of the storage-type fluorescent sheet is formed on the face on the opposite side, that is, the face of the side of the photosensor 10B. Alternatively, the base body of the storage-type fluorescent sheet with a storage-type fluorescent layer formed is prepared so that it is transparent. Moreover, in this case, of course, the above light emitting means 10A is not needed. The signal generating means is not limited to those that detect a light and then generate a signal. Any means can be used, which, when it is irradiated with a radiation, detects the radiation as some noise and then generates a signal.

The cassette that has undergone photography on the storage-type fluorescent sheet 1 contained within as described above is loaded at an appropriate time onto the reading device 20 shown in Figure 3.

The reading device 20 is equipped with a cassette retaining part 20A that retains the cassette 2 in a freely loadable and removable format, and an image signal reading part 20B that reads the image signal accumulated and recorded on the storage-type fluorescent sheet 1. On the cassette retaining part 20A, at the position opposite to the above display part 12A provided on the lid part 2B of the cassette 2, there is a time signal reading

means 21 having a CCD21a. In this signal reading means, light emitted from a lamp 21b is reflected by a reflecting board 21c onto the display part 12A, and the numbers on the display part are read by the CCD21a. The photographing time of the storage-type fluorescent sheet 1 is immediately read by the above time signal reading means when the cassette 2 is loaded into the reading device 20.

As soon as the photographing time is detected, the lid part 2B of the cassette 2 within the cassette retaining part 20A is opened, and then an adhering means 22 is moved into the cassette main body 2A to adhere to and then remove the storage-type fluorescent sheet 1, onto a sheet transferring means 23 that is located nearby. The sheet transferring means 23 transfers the storage-type fluorescent sheet 1 in the direction indicated by the arrow, to the above image signal reading part 20B.

The image signal reading part 20B scans the storage-type fluorescent sheet 1 with an exciting light 24A, such as a laser beam, etc. By the scanning, the light emitted from the sheet 1 is photoelectrically read by a photoelectric reading means 25 that has a photodetector, such as photomultiplier, etc., thereby obtaining an electronic image signal for outputting a visible image. In the figure, 24 is the source of the exciting light, while 27 is a light polarizer such as galvanometer mirror. 26 is a reflecting mirror that reflects the emitted light from the storage-type fluorescent sheet 1 toward a light guide 25a as a photoelectric reading means (the light guide 25a reflects the emitted light and guides it toward a photodetector 25b such as photomultiplier, etc.). The storage-type fluorescent sheet 1 transferred into the image signal reading part 20B is transferred by the sheet transferring means 23 in the direction indicated by an arrow. Using the exciting light 24A polarized almost at a right angle to the transfer direction, the entirety of the sheet is scanned two-dimensionally to produce emitted light. The emitted light is detected by the photodetector 25b via the above light guide 25a. At the photodetector 25b, the emitted light is converted into an electronic signal. The resultant electronic signal is transferred to an image signal reading circuit 28 for processing, and then transferred to a reproduction device described below. After reading, the sheet is removed from the image signal reading part 20B to an erasing device not shown in the figure. By irradiation with an erasing light, the radiation energy remaining on the sheet was released, thereby converting the sheet into a state, in which it can used in photography again.

Thus, from the above reading device 20, an electronic signal representing the photographing time and an electronic signal representing the image signal can be obtained.

Moreover, the accumulated radiation energy on the storage-type fluorescent sheet gradually decreases with time after photography. As a result, the magnitude of the emitted light produced by scanning with an exciting light may decrease (the so-called fading). Accordingly, even if an image signal with the same radiation energy is stored and recorded on the storage-type fluorescent sheet 1, with a long time lag between image recording to reading, the magnitude of emitted light obtained is less than that obtained with a short time lag, using an exciting light source of the same magnitude. This is not a preferred situation. However, with the present reading device, the photographing time is detected internally as described above. If a clock is provided to obtain the reading time within the reading device, the time lag from photography can be calculated by subtracting the photographing time from the reading time. If the above image signal is calibrated in accordance with this time lag, the effect of the fading can be corrected.

As described above, the image signal read by reading device 20 and the signal representing the photographing time are reproduced at the reproduction device 30 on the reproduction surface, on photosensitive film 5. The photosensitive film 5 is transferred to the reproduction device 30 one sheet at a time, by a film-transferring means 31 in the direction indicated by the arrow. By a recording light 33A polarized at a right angle to the transfer direction by a light polarizer 32, such as a galvanometer mirror, etc., the entirety of the film is scanned. The recording light 33A is modulated by a photomodulator 34 after having been emitted from a recording light source 33. As shown by the solid lines in the figure, the electronic signals representing image information and photographing time, sent from the above image signal reading circuit 28 and signal reading means 21, respectively, are transferred to the modulator 34, and then, based on the electronic signals, the modulator 34 modulates the recording light 33A. Accordingly, the image information and photographing time, recorded on the film 5 by the recording light 33A, are thus modulated. The recording is performed on almost the total surface area of film 5, and then it is transferred from the reproduction device 30 to an automatic development device 40 for development. On film 5, the image signal 5A and photographing time 5B are finally reproduced as visible images.

Moreover, the reproduction surface face with the image information, etc. can be displayed reproduced on, in addition to film, also on the display face of the CRT50. In this case, the signals obtained from the image signal reading circuit 28 and signal reading means 21 are simply transferred to the CRT50.

Thus, using the cassette of the present practical example, at the time of photography, the photographing time is displayed simultaneously on the surface of the cassette. Within the reading device, by reading the displayed time, the reading time is transferred to the reproduction device along with the image signal, and there it can be reproduced on the reproduction image face. During this process no manual operation is needed. Moreover, the time displayed on the cassette is very precise.

Moreover, at the reading device, after the above photographing time is detected, time display is no longer needed. Accordingly, a mechanism can be provided within the cassette, with the aid of which, at the cassette retaining part 20A, when the lid part 2B is opened, the above driving means 11 starts normal operation again to display normal time on the display part 12A. Alternatively, cassette 2 is removed from the reading device and then the above operation is performed manually. Moreover, the display part can be in any format, as long as the displayed time can be detected externally by any detection means. In addition to the above practical example, where the photographing time is displayed directly by numbers and then the numbers are detected photoelectrically and reproduced directly on a reproduced image, for the display, a hand 112a rotates as time changes (as shown in Figure 4a), or the number of display bars 212a increase as time changes (as shown in Figure 4b). In these cases, after the position of the hand or the number of the display bars is detected by a detecting sensor, the resultant detection signal is converted and reproduced as numbers, etc., that are suitable for displaying time, on the reproduced image. Moreover, the detection of photographing time is not necessarily performed within the reading device. For example, after photography, the photographing time can be immediately read within the photographic device.

(Effects of the Invention)

As described above, with the cassette for the storage-type fluorescent sheet of the present invention, a mechanism is provided by which the time of the irradiation is displayed automatically upon irradiation with a radiation. By detecting the time, manual operation is not needed, and correct photographing time can be reproduced along with image information.

4. Brief Legends to the Figures

Figure 1 shows an oblique view of the cassette for storage-type fluorescent sheet of a practical example of the present invention.

Figure 2 is a schematic illustration of the above cassette mounted for photography.

Figure 3 is a schematic illustration of the reading device with the above cassette loaded, and of the reproduction device.

Figures 4 (a) and (b) are schematic illustrations of the display parts of some other practical examples of the present invention.

1--- storage-type fluorescent sheet	2--- cassette
2A--- cassette main body	2B--- lid part
4--- radiation	10--- signal generating means
10A--- light emitting means	10B--- light sensor
11--- driving means	11A--- battery
11B--- amplifier	
12--- time display means	12A--- display part

Figure 1

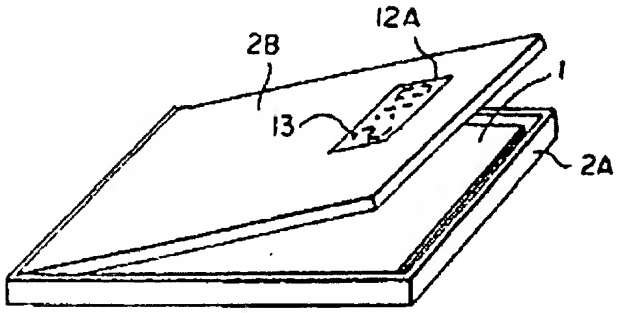

Figure 2

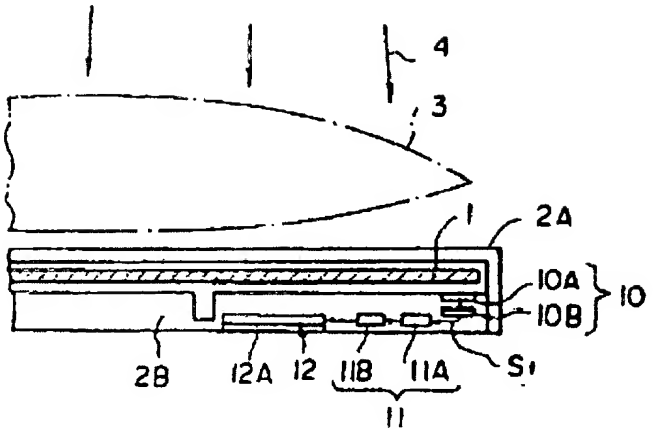

Figure 3

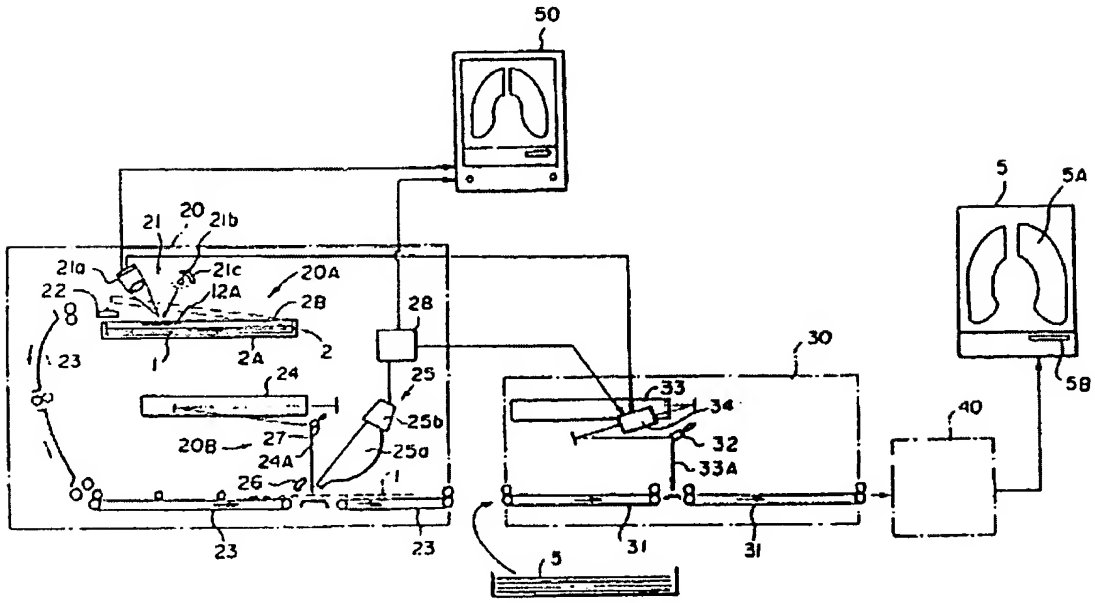

Figure 4